Applied Population Genetic Analysis of Microbes

PLP6621C Spring 2026

3 credit hours

66% online, 33% live and in person for Gainesville students

Thursdays Period 4 (10:40-11:30AM), Fifield Room 2564

Course Description:

This course requires no previous experience in population genetics. Basic population genetics concepts will be introduced, but not derived in this course. Students are expected to have a basic understanding of genetics. The emphasis of this course is on practical aspects of data collection and analysis.

The course is designed to address specific problems faced when analyzing microbial populations. Plant pathogens and other microbes often do not conform to the assumptions underlying population genetic analysis, for example sexual populations.

In this course students will learn to use DNA sequence or genetic marker data to describe population genetic variation and infer evolutionary processes in microbes. The emphasis will be on plant pathogens and examples from the plant pathology literature, but will also be applicable to other microbial populations. Topics to be covered include: sampling strategies, marker types and their evolution, genealogical inference, defining population and geographic structure, and coalescent-based methods for inferring demographic processes (e.g. divergence, migration, and recombination/sex). Methods will be applied in weekly computer labs. Students will have the opportunity to analyze their own population genetic data sets.

Instructor:

Erica Goss

Room 2415 Fifield Hall

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352-273-4650

Office Hours:

Office hours are Tuesdays 3-4 pm and Fridays at noon. You are welcome to stop by my office or make a Zoom appointment for other times.

Course Time/ Location:

Course materials including lectures, reading, computer activities, and assessments are online. There will be a live discussion on **Thursdays Period 4 (10:40-11:30AM)** in Fifield Room 2564 or via Zoom for distance students. Students off-site must have a computer on which they will install freely available software for the computer labs.

Zoom link for discussions and office hours will be available on the Canvas course front page

Course Objectives:

Sophisticated computational methods are increasingly being coupled with population genetic data to infer the demographic history and evolution of populations. The use of these methods in inferring population processes is particularly critical for pathogens whose ecology or epidemiology may not easily be observed. The course will specifically address concerns specific to plant pathogens and microbes, which often clonally reproduce or have mixed reproduction systems.

This course covers challenging material that one cannot master in a single semester and different students will have different reasons for taking this course. You may want to specialize in population genetic analysis in your career, or you may have one chapter of your thesis that requires some population analysis. The course objectives are aimed to those who are looking for basic familiarity with presented topics, but I offer optional content for those looking to understand the material more deeply.

Objectives:

- Students will be able to explain the application of key concepts in population genetics to plant pathology
- Students will be able to discuss how analysis of population genetic data can be used to learn about microbial populations
- Students will be able to evaluate the assumptions, limitations, and appropriate use of population genetic analysis in the plant pathology literature
- Students will be able to conduct population genetic analyses using existing data sets
- Students will be able to interpret results of analyses and explain some limitations

E-learning with Canvas: All students must use Canvas for this course. Syllabus, lectures, reading, assessments, resources, grades, and other materials will be posted on the course Canvas page throughout the semester.

Required Technology:

Computer with standard software is required for assignments, including a web browser and word processor. Most computer labs will be done via web browser, but Rstudio and other freeware software may be used, optionally.

Required and Recommended Textbooks:

There is no required textbook for this course, all material will be provided on the Canvas course site or via course reserves at https://elearning.ufl.edu.

An excellent resource for plant pathologists is **Population Biology of Plant Pathogens: Genetics, Ecology, and Evolution**, by Michael G. Milgroom. If you are a student member of APS, you can obtain this textbook at a discount.

A more technical resource is **Molecular Population Genetics**, by Matthew W. Hahn, published by Oxford University Press.

Assessment:

This is an upper-level course and you are expected to be taking the course to expand your knowledge and improve your research. The assigned quizzes, exercises and project are meant to help you gain experience using these methods and synthesize what you have learned, but they will also be used to evaluate the level of careful thought and effort that you are putting into the course. I do not expect that you will thoroughly understand all the material, this will come with time. Instead, I expect an honest reflection of where you are in the learning process. I encourage you to use whatever resources you need to better understand the material, including AI chatbots, but do not copy/paste any answers. I expect you to use your own words.

Quizzes (10) – 10% of the final grade will come from quizzes associated with each module. They are meant to reinforce learning and can be taken multiple times for full credit. Each quiz has equal point value.

Assignments (12) – 50% of the final grade will come from a series of assignments that differ from the quizzes in that they require activity beyond the lecture content, such as reading a paper or running computer code and interpreting the output, and have a short-answer format. These are open book and can be discussed with your classmates, but must be completed individually. They vary in point value.

Attendance and participation in live discussion (13) – 10% of the final grade will be based on your attendance of and participation in the weekly live discussion. The content of this course is difficult and nuanced. The live discussion is an opportunity to address these complexities in greater depth. *Three* discussions may be missed with no penalty, but I encourage you to watch the recording for your benefit and to help you successfully complete the exercises. Participation includes all forms of contributing to the discussion, including asking questions about the material.

Final Project – Total 30% of the final grade: 20% of your grade will from the final project. Milestones towards the final project are an additional 10% of the course grade. The project will be graded based on a research paper and recorded presentation. Specific guidelines for the paper and presentation will be provided. The project will involve analysis and interpretation of a

population genetic data set. These data can come from your own research or can use published data.

Summary of point values

Assignment type	**Points Each**	**Total Points**
Quizzes	10	100
Assignments	5 to 25	500
Attendance and participation	10	100
Final Project Milestones	25 to 50	100
Final Project (talk and paper)	100	200
Total for course		**1000**

Attendance Policy:

Completing the module activities and required assessments on time, and making appointments for extra help as needed are expected. In this each module builds on the previous module, so you cannot easily skip modules. Please contact the instructor directly regarding any serious illness or prolonged absence. Extensions on assignments will be provided in the case of a valid and documented excuse.

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Grade Points

In accordance with current University of Florida policy, grade points will be assigned as follows.

Letter Grade	Percentage
A	90 or above
B+	87-89.9
B	80-86.9
C+	77-79.9
C	70-76.9
D+	67-69.9
D	60-66.9
E	59 or below

For information on current UF policies for assigning grade points, see

https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Course Schedule:

The schedule is subject to change; changes will be posted on the course Canvas site.

Week		Module	Quiz	Assignment	Points
Jan.	12	Module 1: Introduction to Population Genetic Theory	Yes	Simulations	20
	19	Module 2: Introduction to Coalescent Theory	Yes	Short Answer	5
	26	Module 3: DNA sequence evolution models	Yes	Model selection	25
Feb.	2	Module 4: Microsatellite evolution	-	Short answer	50
	9	Module 5: Recombination	Yes	**Google colab/R - 25**	50
	16	Module 6: Data analysis with SNPs	Yes	**Google colab**	50
	23	Module 7: Genetic and genotypic diversity	Yes	**Google colab/R**	50
March	2	Module 8: Trees and networks	Yes	Google colab	50
	9	Module 9: Testing for population structure		Google colab	50
	16	**Spring Break**	-	-	-
	23	Module 10: Inferring population structure	Yes	Google colab	50
	27	**Final project**		**Milestone 1 due**	**25**
	30	Module 11: Inferring demographic processes	Yes	Canvas?	50
April	**3**	**Final project**		**Milestone 2 due**	**25**
	6	Module 12: Effects of selection	Yes	Canvas?	50
	17	**Final Project**	-	**Milestone 3 due**	**50**
	22	**Final Project**	-	**Paper due**	**100**
	27	**Final Project**	-	**Recorded talk due**	**100**

For academic policies and resources:

https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/